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Cover: Freshly emerged Footman Moth *Nepita conferta* from the cocoon on a brightly painted wall in the Nilgiris. Digital art on Procreate. © Aakanksha Komanduri.

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COMMUNICATION

New population report of the 'Critically Endangered' Golden Himalayan Spike *Phlomoides superba* (Magnoliopsida: Lamiales: Lamiaceae) from Samba and Udhampur districts of Jammu & Kashmir, India

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Abstract: The present study reports four newly discovered populations of the critically endangered *Phlomoides superba* (Royle ex Benth.) Kamelin & Makhm. from the Shiwalik region of Samba and Udhampur districts in Jammu & Kashmir, India. The species holds significant ethnoveterinary importance, particularly its roots, which are traditionally used to treat mastitis and enhance milk production in cattle. However, excessive utilisation for these purposes (82.4%) and a strong competition from the invasive weed *Lantana camara* L. (14.7%), have contributed to a marked decline in its natural populations. To mitigate these threats, informants recommended in situ conservation interventions such as controlling *Lantana camara* invasion and adopting sustainable usage of root tubers. The discovery of new populations not only broadens the known range of *Phlomoides superba* but also enhances its survival prospects by increasing genetic diversity and diminishing the species' susceptibility to extinction. Furthermore, comprehensive phytochemical and pharmacological studies are strongly recommended to scientifically validate its traditional medicinal uses, isolate and characterize bioactive constituents, and assess its potential for the development of novel therapeutic agents in the future. These scientific assessments, combined with conservation-focused utilisation, are crucial for ensuring the long-term preservation and sustainable use of this valuable ethnomedicinal species.

Keywords: Conservation, *Eremostachys superba*, gajar moola, ornamental plant, threatened species, veterinary, women infertility.

Saar: Maujooda adhyayan Parat de Jammu–Kashmir rajya de Samba te Udhampur zilyan de Shiwalik kshetra ch gambhir roop kanne sankatgrast bute *Phlomoides superba* (Royle ex Benth.) Kamelin & Makhm. di chaar navi khoji gayina aabadiyan baare jaankaari dinda ae. Eh prajati dangarein di bimariyan aaste mahatva rakhdian ae, khaaskar isdiyan jarran, jinde upyog paramparaagat taur te dangran ch mastitis di bimari theek karne tein doodh utpaadan vadhane lai kita jaanda ae. Par eh jarran da zarurat ton zyada istemaal (82.4%) tain aakramak jari *Lantana camara* L. kane mukabla (14.7%) is prajati di prakritik aabadi ch tez giraavat da kaaran banea ae. Ina khatryan gi gataane aaste soochna-daatyan ne *in-situ* sanrakshan upaay sujhaaye, jiyan ki *Lantana camara* di avadhi nu niyantrit karna tain jarr-kandan da seemit tain satat upyog apnaana. Navi aabadiyan di khoj na sirf *Phlomoides superba* de phailaav kshetra ge vadhaandi ae, balki aanuvanshik vividhta vadhaake tain vilupt hon de khatre nu ghataake is prajati de bachaav di sambhaavna nu majboot kar di ae. Aggoon, is de paramparaagat aushadhiya upyogan di vaigyaanik pushti karne, jaiv-sakriya ghatkan di pehchaan tain visheshta nirdharan, tain bhavikh ch navi davaiyan banane di sambhaavna jaanchne lai vistrit phytochemical tain pharmacological adhyayan zaroori manne gaye na. Eh vaigyaanik adhyayan, sanrakshan-kendrit upyog de naal milke, is keemti ethnomedicinal prajati de deerghkaalik sanrakshan tain satat upyog nu sunishchit karne lai bahut zaroori na.

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INTRODUCTION

Phlomoides superba (Royle ex Benth.) Kamelin & Makhm. (syn. *Eremostachys superba* Royle ex Benth.), is a significant perennial herb belonging to the tribe Phlomideae of the family Lamiaceae (Srivastava et al. 2017; Garg & Singh 2024). This species is commonly referred to as the Golden Himalayan Spike due to its striking appearance, whereas the vernacular names include 'Gajar moola' in Dogri and 'Ban mooli' in Hindi (Srivastava et al. 2017; Garg & Singh 2024). The plant grows upright and can reach a height of 1.5 m (Image 1). Roots are tuberous and vertical. Stem is hairy, either branched or unbranched. Leaves are simple, hairy, crenate, and have lobed or serrated margins. Leaf petiole is up to 10 cm and lamina is 9.5–19.5 cm in length and 4.5–9.5 cm wide. The plant bears bright yellow flowers arranged in verticillaster spikes with 8–12 flowers at each node. Bracts are oval-shaped. Corolla is yellow and bi-lipped. Nutlets are trigonous and black in colour. Flowering takes place from March to May (Garg & Singh 2024).

Phlomoides superba is geographically distributed across the western Himalayan foothills, found in eastern Afghanistan, Pakistan, and the Indian states of Himachal Pradesh, Jammu & Kashmir, and Uttarakhand (Malik et al. 2014; Singh et al. 2022). The species naturally flourishes on the margins of forests in moist and loamy soil. However, agricultural expansion has resulted in the loss of natural habitats, confining *Phlomoides superba* to the edges of crop fields (Verma et al. 2003; Srivastava 2020). The species holds considerable medicinal, veterinary, and ornamental value. Its root tubers are traditionally used by local communities and tribes for treating mastitis and stimulating lactation in cattle, as well as for various human ailments like liver and stomach issues and gout (Malik et al. 2014; Srivastava et al. 2017; Garg & Singh 2024).

The species has grabbed the attention of numerous researchers because of its beautiful blooms, rarity, declining populations, and ethnobotanical applications (Srivastava et al. 2017). Its population has experienced alarming declines due to factors such as over-exploitation for medicinal purposes, extensive habitat loss due to agricultural expansion & widening of roads, and grazing by wild animals (Garg & Singh 2024). Furthermore, the species exhibits poor sexual reproduction, low seed set, and intrinsic seed dormancy under natural conditions, which exacerbates its low regeneration potential. This has led to inbreeding depression in small, isolated populations and a scarcity of pollinators (Garg & Rao 1997; Verma et al. 2003; Uniyal et al. 2012; Srivastava et al. 2017; Srivastava 2020). Recently, the *Helicoverpa armigera* Hübner has been identified as a significant pest, with its larvae feeding on seeds and causing 90–95% seed loss in highly infested wild populations (Srivastava & Sharma 2025). The present study was conducted to: (i) enlist the new sites where *Phlomoides superba* grows naturally, and (ii) document local methods for its conservation. Both the reporting of new sites and the documentation of local conservation practices for *Phlomoides superba* will contribute to the effective management of the species in the future.

Image 1. *Phlomoides superba* growing naturally at village Badla Denonion.

MATERIAL AND METHODS

Study site

The present study was conducted in Nand (32.587° N, 75.182° E), Badla Denonion (32.623° N, 75.068° E) and Gahani Alna (32.624° N, 75.058° E) villages of district Samba, and in Seral Chowa (32.686° N, 75.096° E) village of district Udhampur, union territory of Jammu & Kashmir (JKUT), India (Figure 1).

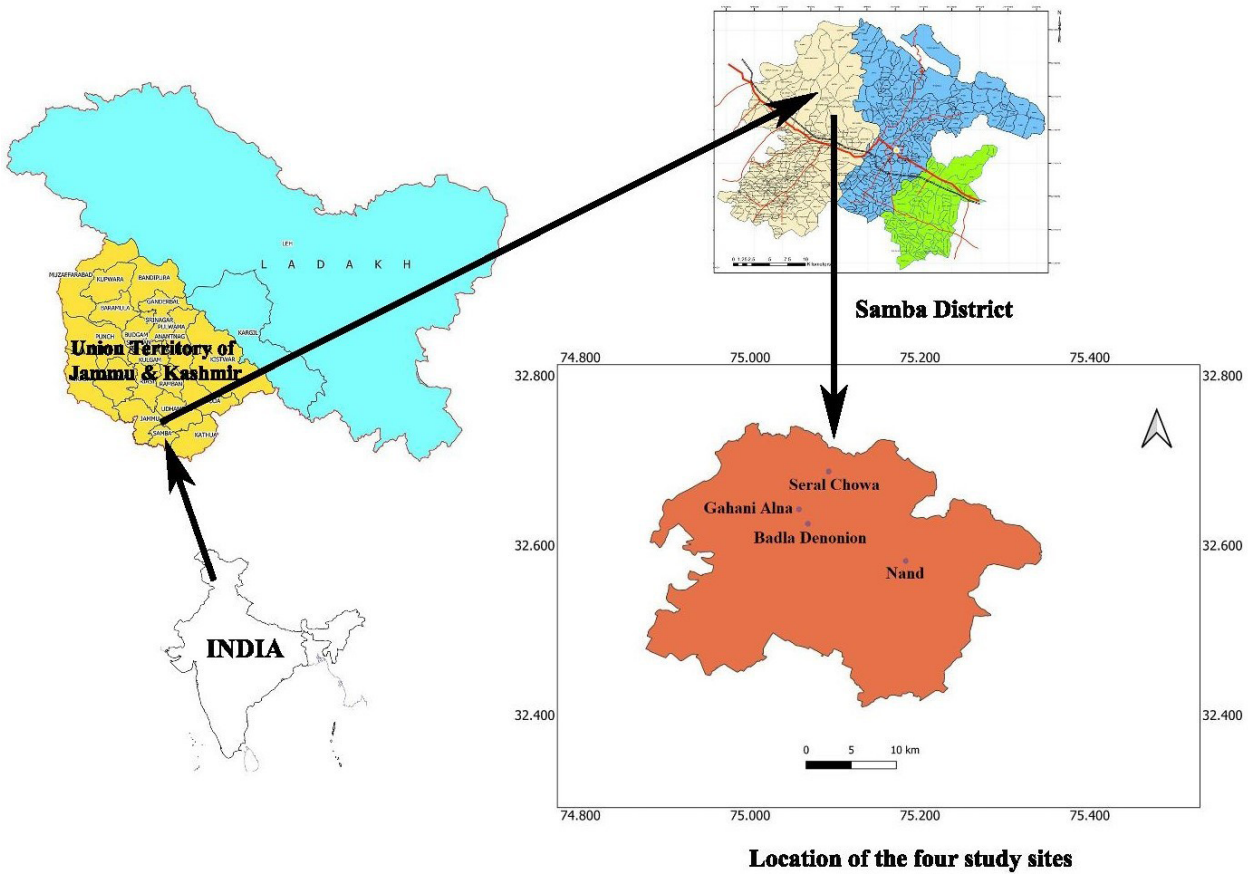

Figure 1. Location map of the study area.

Collection of data

The plant specimen was collected from the study site, preserved, mounted on the herbarium sheet, and submitted to the Herbarium of the Department of Botany, University of Jammu, Jammu, with an accession No. HBJU 17678. A total of 34 elderly people, above the age of 60 years, of the aforementioned villages were interviewed randomly for gathering the information related to *Phlomoides superba* as per a semi-structured questionnaire, and focused group discussions.

RESULTS AND DISCUSSION

Distribution

In the present study, the new population reports of *Phlomoides superba* are from Nand (112 individuals), Badla Denonion (24), Gahani Alna (71), and Seral Chowa (123), marking a total of 330 individuals. The species was found growing on the bunds of agricultural fields, along with wheat crop, in three villages, viz. Nand, Badla Denonion, and Gahani Alna, and from the edges of the forest of village Seral Chowa. These results are as per earlier studies (Verma et al. 2003; Srivastava et al. 2017; Srivastava 2020). Contrary to this, Srivastava et al. (2017) reported one population of *Phlomoides superba* from village Jallow of Udhampur District that grows alongside a small stream. In Seral Chowa Village, *Phlomoides superba* occurred along forest edges with species such as *Ageratum conyzoides* L., *Lamium amplexicaule* L., *Ajuga integrifolia* Buch. - Ham. ex D.Don, *Vicia sativa* L., *Justicia adhatoda* L., and *Carissa spinarum* L., but the site was heavily invaded by *Lantana camara*.

As per Srivastava et al. (2017), *Phlomoides superba* has so far been reported from 10 localities; seven sites from JKUT (Domel, Tara, Bal Shama, Suketor, Panj Grain, Jallow, and Pouni), two from Himachal Pradesh (Gujreda, Kundian), and one site from Uttarakhand (Mohand), distributed between 400 and 730 m altitude (Figure 2). The distribution (405–502 m) of *Phlomoides superba* in the present four sites is well within the range reported by earlier studies (Koul et al. 1997; Verma et al. 2007; Uniyal et al. 2012; Srivastava et al. 2017).

Speaking with the informants about the distribution of

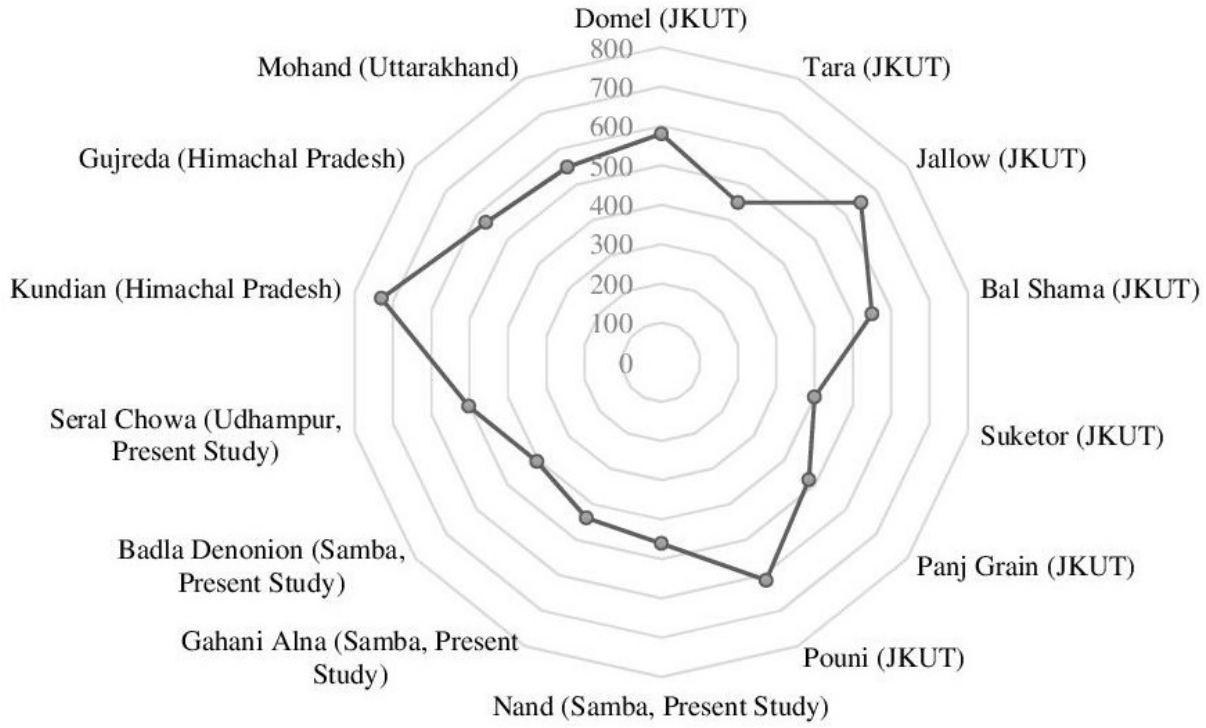

Figure 2. The distribution of *Phlomoides superba* in different altitudes (values in meter above mean sea level). JKUT—Union Territory of Jammu & Kashmir.

Phlomoides superba, it was discovered that the species was found in Labli and Najwal villages of the district Samba around 40–60 and 10–15 years ago, respectively. The first author then visited these locations, and did not find even a single plant growing over there which suggests a decline of the population of the said plant species. Similar observations of declining populations of *Phlomoides superba* from 2,192 to 982 individuals (i.e., 55%) have also been reported by Srivastava et al. (2017) from seven sites in a span of 4–20 yr.

Threat status

In the previous research, *Phlomoides superba* has been categorised in different threat status as 'Vulnerable' (Jain & Sastry 1980; Ved et al. 2003; Samant et al. 2007; Pant & Pant 2011), 'Endangered' (Jain & Sastry 1984; Garg & Rao 1997; Verma et al. 2007; Panwar & Srivastava 2015; Panwar et al. 2015; Pundir 2015), 'Critically Endangered' (Verma et al. 2007; Panwar 2014; Panwar et al. 2014), and 'near to extinction' (Som 1968; Rao & Garg 1994). *Phlomoides superba* is notified in the Gazette of India as a species on the verge of extinction in JKUT, Himachal Pradesh, and Uttarakhand as per Section 38 of the Biological Diversity Act, 2002 (Gowthami et al. 2021). The literature studies make it clear that a significant number of species in the genus *Eremostachys* are either extinct or very close to becoming so (Khan et al. 2022).

Ethnobotanical applications

In the present study, cattle are fed the root tubers to boost milk production and prevent mastitis and body swellings. The fresh tubers of the said species are dug from the ground, washed with water, cut into small pieces, mixed with the cattle feed, and fed to the cattle twice a day for three days. These uses are in accordance with the earlier studies conducted (Srivastava et al. 2017; Garg & Singh 2024). The locals also reported a unique ethnomedicinal use of the species, wherein the root tubers are consumed by women as a traditional remedy for infertility.

Causes of decline in *Phlomoides superba* population

In the present study site, the major cause (82.4%) of the decline in plant populations is the excessive use of root tubers for the treatment of mastitis, and as a galactagogue in livestock. The locals and other tribal groups dig out the root tubers of *Phlomoides superba*, mix it with cattle feed, and give it to the livestock. They also stated that invasion of *Lantana camara* (14.7%), and construction of roads (2.9%) in the natural habitats of *Phlomoides superba* as the associated reasons. These results are in accordance with earlier studies (Uniyal

et al. 2012; Srivastava et al. 2017; Garg & Singh 2024). The other factors are: poor fruit and seed set, which is primarily caused by pollinator restrictions (Verma et al. 2003), and poor capacity for regeneration (Garg & Rao 1997; Uniyal et al. 2012). Due to its attractive flowers, *Phlomoides superba* is considered to have strong ornamental value. However, this aesthetic appeal has encouraged its collection and use beyond its natural habitat, contributing to increasing anthropogenic pressure on wild populations (Pundir 2015).

Conservation of *Phlomoides superba*

Numerous measures have been undertaken for the conservation of *Phlomoides superba* in view of its critically endangered status and the severity of threats it faces. Locals are making efforts to conserve *Phlomoides superba* by raising seedlings and cultivating it in their fields; however, these attempts have met with limited success due to poor seed set and low germination rates. Consequently, in situ conservation remains the primary strategy, with villagers actively removing the invasive weed *Lantana camara* and practicing sustainable utilisation of *Phlomoides superba* to support its survival in the wild.

The survival and viability of *Phlomoides superba* seeds remain topics of debate. Earlier studies reported limited or negligible viability; however, natural regeneration in the wild suggests otherwise (Srivastava 2020). According to Garg & Rao (1997), seeds remain viable for only one month, while Sunnichan & Shivanna (1998) and Verma (2001) reported viability periods of five and eight months, respectively. Furthermore, Panwar & Srivastava (2015) observed that seeds stored at low temperatures retained viability for up to 12 months, and Srivastava (2020) recorded enhanced germination rates under such conditions.

Successful conservation and cultivation of the species require the development of efficient propagation protocols. Although in vitro propagation attempts have been made, these methods have not yet been widely adopted (Sunnichan & Shivanna 1998; Panwar et al. 2015). Ex situ efforts by Verma et al. (2003) demonstrated the feasibility of raising plants and distributing seeds to universities and national institutes across India. The first author has also collected seeds of the species, germinated them, and distributed seedlings to Lovely Professional University, Phagwara, Punjab; Government Degree College for Women, Kathua; and Government Degree College for Women, Gandhinagar, Jammu, to promote ex situ conservation efforts. More recently, Srivastava (2020) achieved successful ex situ propagation using seeds treated with cold stratification and GA_3, resulting in 84% and 82% germination success, respectively.

CONCLUSION

The locals were well aware of traditional uses and dwindling populations of *Phlomoides superba*. Further surveys are required to document the population if any, from different locations and analyse its conservation status. Phytochemical analysis and pharmacological studies may also be conducted for the identification of chemicals responsible for the ethnomedicinal properties, and for the development of novel drugs. Additionally, this will aid in the preservation of this lovely plant that is in danger of going extinct.

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Author contributions: NB—research design, conceptualization, field data collection, data compilation, and writing the manuscript. HU— methodological guidance, writing and editing the manuscript, support and supervision. RN—field data collection, taxonomic assessment. RKM— research design, conceptualization, methodological guidance, data analysis, species verification, writing and editing manuscript, support, and supervision.

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